

PLANT-PARASITIC NEMATODES ASSOCIATED WITH THE AQUATIC PLANTS
CERATOPHYLLUM DEMERSUM AND *HYDRILLA VERTICILLATA*¹

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Aquatic plants, with the exception of rice, have received very little attention as hosts of plant-parasitic nematodes. One hundred fifty-two species of nematodes have been reported from cultivated rice, *Oryza sativa* L. (2,6). Recent surveys showed that two submersed aquatic plant species, *Ceratophyllum demersum* L. and *Hydrilla verticillata* (L. f.) Royle were frequently encountered in lakes and streams in Florida (1,4). The latter plant is a serious aquatic weed in Florida (5). The control of aquatic weeds is mainly attempted by applying chemicals which may have a detrimental impact on the aquatic environment. Research emphasis is presently being placed on biological control of aquatic weeds.

Ceratophyllum demersum, commonly called coontail, is a perennial submersed plant that has slender elongated stems with numerous lateral branches, but it has no roots. The leaves are whorled and crowded near the tips of the branches which give the plant its 'coontail' appearance (4,7). The plant is cosmopolitan and native to the United States.

Hydrilla verticillata is a submersed, perennial, rooted plant with long, branching stems which form dense mats. Hydrilla is an exotic plant in the United States and was probably introduced into Florida from South America around 1960 (5). Presently it ranks as the most noxious aquatic weed in Florida, infesting some 45,502 acres of water (8).

Nine phytoparasitic nematode species were associated with *C. demersum* in nine different bodies of water in Florida (Table 1). *Hirschmanniella caudacrena* Sher, 1968 was found in high numbers in the stems and leaves of coontail from Rodman Reservoir and Lake Newnan (3). Nematode densities were as high as 58 nematodes per gram of fresh tissue. Major symptoms of nematode infestation are varying degrees of plant chlorosis, irregular growth in the form of twisted stems, and fewer side shoots development (Fig. 1). Plant tissue consists of one-third air spaces in which the nematodes move freely. Chloroplasts are very abundant in healthy leaf cells (Fig. 2), but were less abundant in damaged nematode-infected leaves (Fig. 3). Recent laboratory tests have verified that *H. caudacrena* is pathogenic to coontail.

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Table 1. Plant-parasitic nematodes associated with coontail,
Ceratophyllum demersum and *Hydrilla verticillata*.

Aquatic plant/nematode	Locations*	References
<i>Ceratophyllum demersum</i>		
<i>Aphelenchoides fragariae</i>	8, 1, 13	1
	10	**
<i>Aphelenchoides</i> sp.	3, 9, 14	**
<i>Criconemoides</i> sp.	14	**
<i>Hirschmanniella caudacrena</i>	7, 8, 11, 14	3, **
<i>Hirschmanniella</i> sp.	14	**
<i>Hoplolaimus tylenchiformis</i>	14	**
<i>Pratylenchus</i> sp.	14	**
<i>Trichodorus</i> sp.	14	**
<i>Tylenchus</i> sp.	14	**
<i>Hydrilla verticillata</i>		
<i>Aphelenchoides fragariae</i>	4, 7, 9, 12	1
	3, 9	**
<i>Aphelenchoides</i> sp.	4, 5, 14	**
<i>Criconemoides</i> sp.	4, 7, 9, 12	1
	14	**
<i>Dolichodorus</i> sp.	12	**
<i>Helicotylenchus</i> sp.	12	**
<i>Hirschmanniella caudacrena</i>	4, 7, 9, 12	1
	4, 8, 9, 11, 14	**
<i>H. gracilis</i>	4, 7, 9, 12	1
<i>H. oryzae</i>	2	***
<i>Hirschmanniella</i> sp.	6, 14	**
<i>Trichodorus</i> sp.	14	**
<i>Tylenchorhynchus irregularis</i>	4, 7, 9, 12	1
<i>Tylenchus</i> sp.	4, 7, 9, 12	1
	14	**
<i>Xiphinema americanum</i>	4, 7, 9, 12	1

*Abbreviations of locations are as follows:

- | | |
|--|--------------------------|
| 1. Aquatic plant rearing pool, FL | 8. Lake Newnan, FL |
| 2. Chikkana Kere, near Bangalore, India | 9. Lake Orange, FL |
| 3. Cross Creek, FL | 10. Lake Panasoffkee, FL |
| 4. Crystal River, FL | 11. Lake Rousseau, FL |
| 5. Fisheating Creek, FL | 12. Manatee Springs, FL |
| 6. Florida Power & Light Company, Indiantown, FL | 13. Random survey, FL |
| 7. Lake Lochloosa, FL | 14. Rodman Reservoir, FL |

**Gerber, K. & G. C. Smart, Jr. unpublished survey.

***Collected by Dr. G. R. Buckingham and C. A. Bennett.

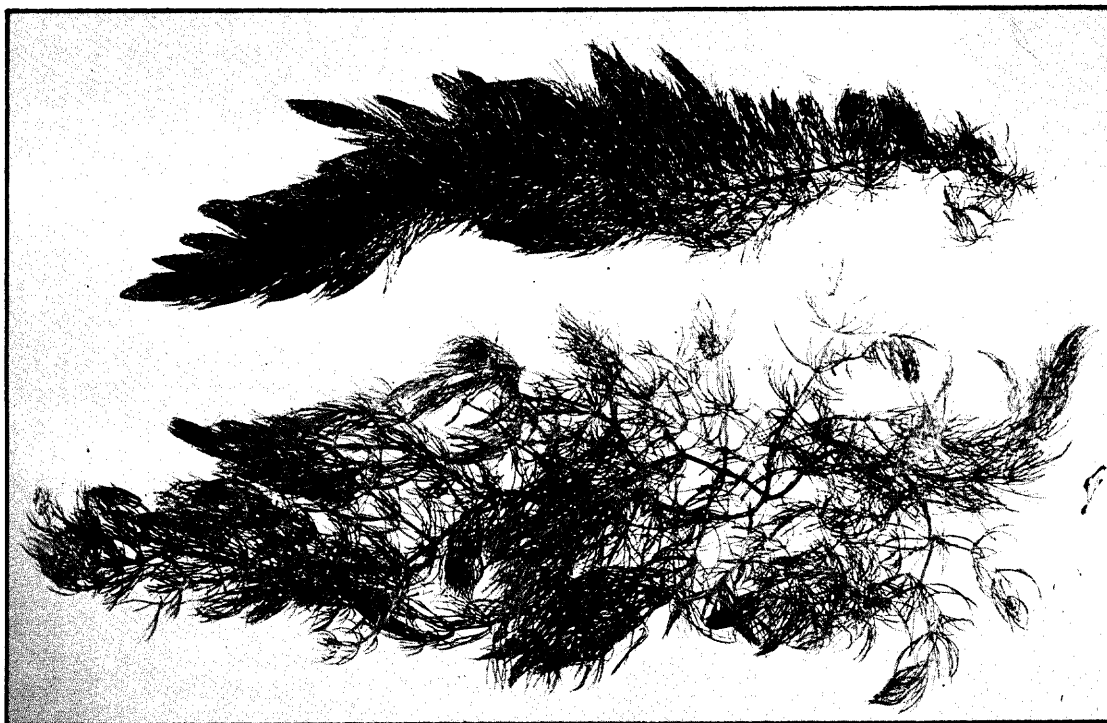


Fig. 1. Coontail (*Ceratophyllum demersum*) showing healthy (top) and *Hirschmanniella caudacrena*-infected plant (bottom).

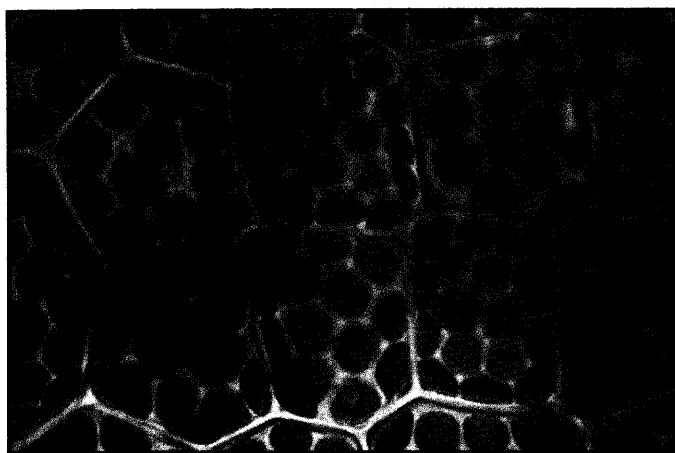


Fig. 2. Healthy coontail leaf showing abundance of chloroplasts in the cells.

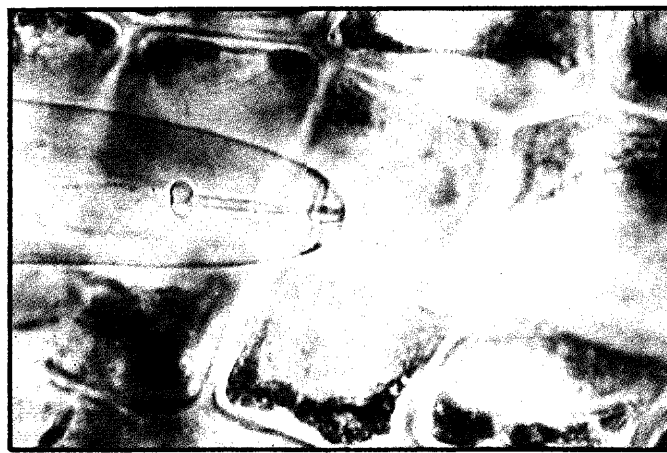


Fig. 3. *Hirschmanniella caudacrena* infected coontail leaf showing damaged chloroplasts.

A total of 13 nematode species are known to be associated with *Hydrilla verticillata* (Table 1). In our survey (unpublished) we frequently found *Aphelenchoides fragariae* (Ritzema Bos, 1891) Christie, 1932 in the apical buds. *Aphelenchoides fragariae* was previously reported to cause serious damage to the submersed plants *Cabomba* sp., *Peplis diandra* Nutt. ex DC., *Limnophila* sp., and *Potamogeton* sp., grown commercially in Ft. Lauderdale, Florida (9).

In our survey, the hydrilla plants infested with *A. fragariae* originated from Cross Creek and Lake Orange, Florida. Another *Aphelenchoides* species was found in hydrilla buds at Fisheating Creek, Lake Newnan, and Rodman Reservoir. Of 20 to 30 hydrilla buds dissected, the mean nematode densities were 47 (Cross Creek), 17 (Lake Orange), 5 (Fisheating Creek), 8 (Lake Newnan), and 10 (Rodman Reservoir) per bud, respectively. The highest density from an individual sample was 217 *A. fragariae* from one bud at Cross Creek. Generally, nematode densities were higher in green tissues while only a few nematodes were present in necrotic tissue. All life stages, including eggs, were present in infected buds. Eggs were laid in a gelatinous material in the area of the growing point of the buds. The nematodes fed ectoparasitically on the meristem, the leaf primordia, the bud scales, and at the base of buds. The apical meristem of many buds was damaged or completely destroyed.

Aphelenchoides species are active swimmers and are able to move in any direction in the water. This mobility promotes the spread of nematodes to new host plants, and could be an important trait in regard to the possible use of this nematode for biocontrol of *Hydrilla verticillata*.

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